

National Science Foundation (NSF)
Directorate for Computer and Information Science and Engineering (CISE)

CISE Management Response to the
Division of Computer and Network Systems Division (CNS)
Committee of Visitors Report
May 11-13, 2009

Introduction

The Division of Computer and Network Systems Division (CNS) of NSF's Directorate for Computer and Information Science and Engineering (CISE) held a 3-day Committee of Visitors (CoV) review meeting on May 11-13, 2009, at NSF. The purpose of this review meeting was to provide NSF with an assessment of the quality and integrity of program operations pertaining to proposal decision; and to comment on how the results generated by awardees have contributed to the attainments of NSF's mission and strategic outcome goals. The CoV review covered the FY 2006 through FY 2008 period.

The CoV consisted of 32 members, selected for their expertise related to the goals of CNS programs. While ensuring adherence to NSF's conflict of interest policies, a major goal of CoV member selection was to provide a balance with respect to geographical regions, the type of institutions supported through the Division's programs, gender diversity and representation from minorities and underrepresented groups. The CoV was organized into 5 subcommittees, reflecting the organization of CNS programs. The subcommittees focused on the following five areas: Computer Systems; Network Systems; Cyber Trust; Research Infrastructure; and Education and Workforce. The CoV subcommittees were charged with preparing detailed reports on each CNS programmatic cluster, and the CoV as a whole was charged with preparing a comprehensive summary report.

The CoV members were provided with a comprehensive web site of information relevant to program operations and proposal decisions, including past CoV reports and CNS responses, a detailed self study, a random sample of jackets awards and declinations, workshop reports and other materials pertaining to programmatic activities managed by the CNS Division for the period under review (i.e., FYs 2006 – 2008). The CoV also heard presentations from and met with several Program Officers in each of the Division programmatic clusters. For the duration of the CoV review meeting, CNS staff provided support to the Committee and responded to new requests as they arose.

The CoV evaluated CNS performance in the context of the CoV criteria developed by NSF. These criteria were used as a guide by the CoV to probe, assess and evaluate CNS performance.

CISE management expresses its gratitude to the members of the CNS CoV, and their Chair and Co-Chair, for their commitment, hard work and dedication to this important activity; for their perceptive analysis and thoughtful suggestions for improvement of CNS programmatic and administrative activities; and for their very valuable contribution to NSF's mission and strategic goals.

Overall Performance and Goals

The CoV report provided a deep analysis of the CNS program portfolio with respect to the integrity and efficacy of processes used to solicit, review, recommend, and document proposal actions; the quality and significance of the results of the Division's programmatic investments; and the relationship between award decisions, program goals, and Foundation-wide programs and strategic goals. We found the COV report to be comprehensive, fair and constructive.

Overall, the report provides a positive assessment of the Division's operations and outcomes and commends the Division for its high standards, efficiency and impact. As stated in its broad summary, the *"CoV was impressed by the scope and quality of the work underway in the CNS Division, felt that the programs are well managed, and was convinced that the scientific impact of the research CNS is supporting is substantial"*. The CoV also *"felt that CNS is positioned to have even greater impact on the future as the country begins to develop cyber-based technologies for critical sectors such as medical, financial, and power"*.

The CoV report is also very positive in its evaluation of each of the Division's programs. Overall, the CoV subcommittees found that CNS Program Officers were committed to maintaining a portfolio of cutting-edge, high-quality research projects that is effective in furthering the Directorate's and NSF's goals of advancing discovery, learning and research infrastructure. They also commended the Program Officers for their hard work and commitment to ensuring GPRA performance standards and efficient management of their respective programs.

The CoV report also makes insightful observations, raises some concerns and provides a series of major findings, specific recommendations and comments. In the sections below, we discuss the measures we intend to take to address the concerns and respond to the CoV's recommendations. The responses are organized to reflect the CoV report structure and topics. The responses are preceded by underlined quotations from the CoV report. When appropriate, similar concerns and recommendations expressed in different parts of the report are grouped and answered together.

Management Response to CoV Executive Overview

Overall the CoV found that CNS is to be commended of its high standards, efficiency and impact.

We are delighted with the positive assessment of the CNS Division provided by the CoV. We agree with the CoV members that “CNS is positioned to have great impact on the future as the need to develop secure cyber-based systems and technologies for critical sectors of our Nation continues to arise.” CNS will continue to improve on its management processes and its support of cutting-edge, high-impact, high-quality research and education and research infrastructure projects.

The CoV was concerned about the inadequacy of resources available for program managers to attend the top-ranked conferences in the areas of their own programs. The CoV recommended that at a minimum, CNS program officers must have funding to attend one or two top-ranked conferences per year.

CISE shares the CoV members’ concern about budgetary resource constraints and their impact on the directorate’s responsibility to: provide effective award management; to conduct effective outreach to underserved populations; and to provide professional development and enrichment opportunities for our staff to ensure they remain knowledgeable about the science and engineering frontier. Unfortunately however, funds available for award management, outreach, and professional development and enrichment are limited by Congressional appropriations, making it necessary to prioritize among very worthy competing organizational needs. Responding to the CoV’s specific concern, our records do show that Program Officers are able to attend at least two professional meetings each year. However, this will become an increasingly challenging norm to attain because as CISE continues to increase the number of larger projects it supports (such as the Large core awards and Expeditions awards) project management and oversight resource needs increasingly compete with the need to send Program Officers to professional meetings. NSF and CISE management remain committed to making a strong case to the Congress that the appropriation of adequate funds for travel that permits effective project management, outreach, and professional enrichment is essential to NSF’s mission and to the effective management of the organization.

The CoV commented that CNS has been more aggressive about revamping programs than tracking the impact of program changes on the research community. The CoV further recommended that CNS maintain program balance, engage the research community in establishing and periodically refocusing CNS programs, and take action to ensure that there is broad community buy-in and participation in tactical decision-making.

As indicated in the CoV report, a wave of disruptive technologies and applications, coupled with the explosive growth of social networks, as well as advances in science and engineering in general, are driving a sweeping change in the use of computing. In such a fast-changing environment, CISE and CNS strive hard to establish and maintain a portfolio of transformative research programs that support broad research areas while invigorating and stimulating emerging paradigms and technologies. Periodically, CISE management makes timely adjustments to its existing programs and creates new ones in response to emerging opportunities defined by the research community.

To explore new research directions and quantify the effectiveness of its current research programs, CNS engages the community in the following ways:

- CNS hosts PI meetings and workshops in emerging areas of science and engineering, inviting experts to identify emerging opportunities and discuss future research directions. The establishment of the Cyber Physical Systems (CPS) program, which was created in response to the report of the President's Council of Advisors in Science and Technology (PCAST) entitled "Leadership Under Challenge: Information Technology Research and Development in a Competitive World," is an excellent example of how CISE responds to community-identified research priorities. Following release of the PCAST report and a resulting series of workshops organized by different CNS sub-communities, the CPS program evolved from a focus area in one CNS program (Computer Systems Research) into a cross-directorate initiative involving CISE and the Directorate for Engineering, with almost an order of magnitude increase in investment level.
- CNS establishes ad-hoc expert panels of visionaries and researchers to gauge the quality and potential for game-changing impact of CNS programs. A panel of external experts has been organized to review FIND's current research portfolio and to explore new directions in future Internet architectures.
- CNS supports the Computing Community Consortium (CCC), a proxy organization for the computing research community. The CCC operates under the leadership of the Computing Research Association (CRA). Its primary role is to facilitate research vision setting by the computing research community, evaluate impact of new research directions, and catalyze community thinking regarding major initiatives in pursuit of audacious and transformative research goals. For example, under the leadership of the CCC, a series of workshops were held to explore problems and research directions in the multidisciplinary field of network science and engineering. The workshops were structured to bring

together distributed systems and networking researchers with researchers from closely-related fields, such as economics and social sciences, to explore research challenges related to building future Internets. The resulting [NetSE Research Agenda](#) report is publically available for comments.

- CISE also supports studies conducted by the Computer Science & Telecommunications Board (CSTB) of the National Academy of Science. Their reports also provide insightful recommendations and influence CISE research directions. CNS sponsored several CSTB studies including Software [for Dependable Systems: Sufficient Evidence?](#), and the [CSTB Computational Thinking workshop series](#).
- CISE draws upon its Advisory Committee to provide up-to-date information about the state-of-art of the field, facilitate the Directorate's response to changes in CISE sub-disciplines and the balance among them, and advise on the impact of CISE programs. Several CISE AC members were instrumental in shaping the direction of the Cyber-enabled Discovery and Innovation program.
- Last but not least, input from the COV reviews, held every three years, are also very valuable.

CNS will continue to explore new ways to engage its research constituency in its quest to identify new research directions and opportunities and to assess the impact its research programs may have at the computing frontier.

Response to Major Findings

The CoV report presents a series of major findings. The responses are organized according to the three main parts of the CoV report; each response is preceded by an underlined, bold quotation extracted from the report.

Broadly, the CoV believes that overall CNS funding levels continue to be less than what is needed.

This concern was also expressed by the CCF and IIS CoVs. Of course, we agree with the CoV finding that adequate support for research, education and research infrastructure in computing is a national imperative because of the major role that the information technology R&D community has been playing in catalyzing the growth of our nation's economy, creating new jobs and enhancing national competitiveness. With a 20% increase in the number of proposals submitted, coupled with a severe decrease of academic research funding as mission agencies adjust their priorities, CISE has become the principal source of federal support for

fundamental research in the computing fields. NSF and CISE are committed to continuing to present a compelling argument for increased support of (i) transformative, fundamental research, (ii) comprehensive, high-quality education and (iii) far-reaching research infrastructure in computer and information science and engineering.

Part A – Integrity and Efficiency of the Program Progress and Management

The CoV was satisfied that CNS is performing above their expectations and, in many cases, substantially exceeding their expectations.

CNS is pleased with the CoV's positive assessment of the integrity and efficiency of the processes and management of the Division's programs. CNS is also pleased to note that the CoV has concluded that concerns about CNS panel diversity, raised by the previous CoV, have been resolved in a satisfactory manner.

The CoV identified some cases in which CNS seems to be stretching limited funds and raising proposal rate success rates in part by negotiating budgets and timelines. This can be appropriate if a budget is genuinely too high for the proposed work. However, it can also harm and scientific work and broader impacts, and in the long run reduce scientific output per dollar invested. The tradeoff needs continuous monitoring and adjustment.

The CCF and IIS CoVs expressed similar concerns about budget reductions. Of course, Program Officers in all three divisions negotiate budgets and timelines for a variety of reasons. These include: removing items from a proposed budget that are not ultimately justified for the proposed work (for example, excessive travel); modifying the scope of work in response to reviewers' comments or concerns (such as, eliminating a weaker element in a proposed project); and seeking equity across awards by funding similar projects at similar levels (such as amount of graduate student or faculty support). Program Officers invest considerable thought in this exercise, since they are aware that freeing up funds on one project may ultimately enable another project to be supported. We are wholly committed, however, to ensuring that budget reductions are not harmful to the scientific value of the projects we support. Consequently, we will adopt a practice already proving effective in our sister division, the Division of Information and Intelligent Systems, by asking Program Officers to report the rationale for budget cuts of more than 10% in their Review Analyses. This will allow for greater reflection on the potentially negative impact of budget reductions, and will provide enhanced transparency at the Program Officer, Program Cluster, and Division levels, thereby allowing for continuous monitoring and adjustment.

It was brought to the CoV attention that CNS panels appear to be overly harsh in their proposal ratings. A consequence is that genuinely outstanding work sometimes doesn't receive the highest rankings. The CoV sampled reviews and concluded that the CNS program managers are correct in this respect. The CoV stated that we accept that the issue is more than just cosmetic. Given the goal that CISE proposal ratings be undertaken on the same scale used by other directorates, we believe that the best strategy is to focus on educating panelists and external reviewers about the NSF rating scale and how it is normally used.

We agree with the CoV's assessment that the propensity of CNS and CISE reviewers is to rate proposed work overly conservatively. CNS will follow the recommendation of the CoV and will develop a process to increase panelists' understanding and awareness of this issue. Specifically, we will collect and compare NSF-wide statistics about reviewers' ratings of proposals from the NSF Enterprise Information System (EIS). The resulting data will be discussed at the beginning of every review panel meeting, and, when appropriate, as part of out-reach activities and informational meetings.

The CoV noted that individual reviews and panel summaries continue to be of variable quality. On the other hand, the proposal feedback provided by the Program Officers was highly impressive, showing tact, balance and sophistication.

CNS is committed to improving the quality of its review process. As noted by the CoV members, Program Officers have been extraordinarily diligent in providing useful feed back to PIs. We consistently try to impress upon our reviewers that they should provide detailed reviews that describe both the strengths and weaknesses of the proposals being considered. Furthermore, Program Officers strive hard to educate panelists to ensure that panel summaries address NSF review criteria and are clear in their justification of the panel recommendations, particularly when inconsistencies exist in the individual reviews. CISE will continue to explore new ways to ensure that panelists' reviews and panel summaries provide useful feedback to PIs.

Part B – Results of NSF Investment

With respect to part B (impact), we were extremely impressed. CNS has maintained a consistent track record of funding some of the most important computer science research underway in the nation today. CNS-funded research work is impacting the science base and the commercial sector in measurable, vital ways and responding to urgent national priorities in cybersecurity.

We are delighted that the CoV recognized the impact CNS funding has had on the research enterprise.

The “education and workforce” cluster of programs should be applauded for its impact with respect to promoting NSF’s mission with respect to “Learning,” developing the science and engineering workforce, and promoting scientific literacy among the broadest possible spectrum of society. However, Program Officers in this area are having a particularly difficult problem with reviewers and review quality, putting them under load and stress.

We recognize that identifying willing, able reviewers is a challenging task. Several Program Officers use an online system to allow potential reviewers to describe their interests and register to review proposals and/or to participate in review panels. We will explore using a similar approach to increase the number and enhance the diversity of Education and Workforce (EWF) program reviewers.

The REU program, with its exciting emphasis on computational thinking, is under-funded. Good REU sites and programs have been terminated to allow new ones to start, and we were not shown evidence to support the belief that REU programs become self-sustaining. If these successful REU sites shut down when funding was shifted, the effect was to punish success.

The REU Sites program provides an excellent opportunity to engage undergraduate students in research. CISE recognizes providing research experience to undergraduate students is one of the most effective avenues for attracting and retaining talented undergraduates in computer science and engineering. In 2009, 56 CISE REU Site proposals were received. Of these, sixteen were selected for award with FY 09 funds; eight of the sixteen were renewals. Thus, the funding rate was 28% for all proposals, a higher funding rate than in most programs. In selecting proposals for award, CISE seeks to recognize the success of the most promising renewal REU Sites, while also providing opportunities for PIs to establish new REU Sites. CISE will continue its strong commitment to support the REU Site program with a view to ensuring that successful REU Sites remain competitive.

The CoV suggests that CNS should consider surveying its research constituency to quantify the effectiveness of its research programs in supporting computing and networking systems research, as perceived by the individuals actually doing the research.

CNS holds PI workshops, informational and meetings and research directions setting workshops to inform and gather feedback from the community about its programs. In fact, though, it is this very CoV process that NSF uses to ask the research community (or its representatives) to assess the effectiveness of its programs.

The CoV commented that CNS has worked with many different programmatic structures in the general area over the years: ITR models, multi-institutional centers, smaller directly-funded efforts, GENI. Dialog with the research community could also clarify the question of which models work best for the people actually doing the work, while also yielding factual insight into the adequacy of overall funding levels today. In particular, we are curious to know how the overall level of overhead has evolved for CNS-supported researchers, as a function of the amount of research they are doing.

In response to the emerging needs and challenges of our field, CISE uses different programmatic structures to establish and maintain a balanced portfolio of cutting-edge core- and multi-disciplinary programs. The CISE Advisory Committee supplements NSF knowledge by providing up-to-date information on the state of the field, performing specialized policy-informing functions facilitating CISE's response to ongoing changes and emerging opportunities in the CISE sub disciplines and balance among them, and identifying situations requiring policy attention. To determine how different models work best to achieve NSF funding objectives, we frequently fund studies focused on gaining better understanding of the impact of the different models (including their effect on investigators); for example, consider the work done by [Kiesler et al](#) on the effectiveness of the KDI and ITR program models.

CNS should improve its mechanisms for tracking the impact both of new policies (such as once-annual submission deadlines) and also of the status of its larger programs, especially if cross-funded (such as MRI, REU, GENI) or constituted as large centers with internal proposals, review processes and funding allocations (such as GENI, TRUST, etc). CNS (or CISE as a whole) should develop a plan to evaluate impact of the various "proposal rate limiting" mechanisms created in 2008; CNS should survey the community, asking: Are researchers funded adequately, using efficient program structures, to do the best possible work with the lowest levels of overhead consistent with quality, oversight and community building?

There are many factors driving us towards closely synchronized proposal submission deadlines. Such deadlines allow us to transfer proposals to the most appropriate program/panel. Further, since funding decisions in one program may affect decisions in other programs, a long lag between proposal deadlines often has an adverse impact on proposal dwell time and PI customer service. Limitations imposed by the federal budget cycle also influence our program solicitation strategy. In transitioning to annual submission deadlines, we undertook a comprehensive analysis of all of these factors and others (e.g. the submission deadlines for other NSF programs) to try to identify an effective program solicitation approach aimed to provide our PI community with a sense of stability, thereby

allowing its members to internalize the CISE proposal submission calendar and plan ahead for their proposal submissions. On the subject of junior faculty, the current system is designed in the understanding that junior faculty are most likely to submit proposals in December (Small proposals), July (CAREER proposals) and August (Medium proposals).

As CNS staff turnover occurs, CNS should institutionalize mechanisms for educating new staff about the status and accomplishments of complex, cross-cutting efforts so that knowledge acquired by the staff members who created a program will not be lost as that program is handed off to new generations of program officers at CNS.

To maintain the continuity in program management, CNS' recruiting strategy is designed to allow for an overlap between outgoing and incoming Program Officers. The structure of the program cluster within CISE also helps to maintain the continuity of program management, since the cluster members support one another. Furthermore, CNS has developed a "Roles and Responsibilities" document that highlights the basic management processes and programmatic procedures to facilitate the smooth integration of new Program Officers into their assigned cluster teams. We agree with the CoV, however, that long-term, sustainable and institutionalized mechanisms must be put in place to ensure continuity in program management. To this end, CISE has charged an internal committee to develop a Succession Plan for the directorate, which includes the development of a standard mentoring process to help new staff, including Program Officers, transition seamlessly into new positions.

The CoV noted that CNS walks a delicate tightrope reflecting tensions between focused programs and programs that welcome a wide breadth of ideas and out-of-the-box research. CoV had many bullets under this comment. The CoV also stated that the goal of community building must not interfere with the more primary goals of achieving the highest possible quality of scientific research, education and outreach.

CNS has always welcomed and will continue to welcome high-risk, high-payoff, transformative research projects that are at the cutting edge of science and technology. Such projects are funded under core and cross-cutting programs, special projects and other programs such as the Early-concept Grants for Exploratory Research (EAGER) and Grants for Rapid Response Research (RAPID) programs. PIs are also encouraged to discuss their innovative ideas with Program Officers and seek guidance on where to submit their proposals. CISE agrees with the CoV that the goal of community building must not interfere with the more primary goal of achieving the highest possible quality of scientific research and education. CNS is committed to striking the right balance between these two important goals.

Specific CoV Recommendations not Addressed Earlier in this Document

The CoV noted some irregularity in the use and value assigned to “broader impacts” statements. Some areas make effective use of these statements. In others, the concept of broader impacts is less obvious. CNS may need to educate proposal writers, perhaps by sharing examples of particularly good broader impact statements used by others funded in the same programs.

Ensuring that CISE PIs consistently address broader impacts in their proposals has been an ongoing challenge in the directorate and in the agency. NSF and CISE have provided the community with access to information about Broader Impacts, including representative examples that can be accessed from CISE solicitations. Further, at every CISE panel meeting, reviewers (who are invariably PIs themselves) are briefed on the importance of addressing Broader Impacts in their review of proposals. We remain committed to doing more to help the PI community respond more effectively to this important criterion. In FY 2010, CISE will publish a Broadening Participation in Computing Strategic Plan that, amongst other things, will provide CISE PIs with access to resources and ideas they can leverage to better address NSF’s Broader Impacts criterion. Furthermore, we plan to build on the success of several NSF-led broader impact initiatives, such as the Broader Impacts Showcase organized by the Division of Chemistry of the Mathematical and Physical Sciences Directorate and other similar initiatives in diversity and broadening participation organized by the Engineering Directorate to explore new ways to educate the community about broader impacts and allow principal investigators to discuss and engage in a wide range of broadening activities that can enrich CISE’s grant portfolio.

The CoV also recommended that NSF and CNS might benefit from a means of tracking programs using modern project management tools (allowing timely analysis after the fact).

Access to state-of-the-art project management tools are essential to allow for timely program analysis. In this regard, CISE and the Directorate for Social, Behavioral and Economic Sciences established a joint subcommittee of their Advisory Committees to explore new frameworks that can lead to effective proposal portfolio management tools. The main objective of this subcommittee is to engage researchers in visualization, machine learning, process management and other related fields to investigate new ways in which state-of-the-art technology can be used to better understand research portfolios and allow flexibility in the actual tools and processes used to achieve sound program analysis and tracking.

Program officers need more logistic resources, such as adequate personal travel resources; and more staff support would have a dramatic positive impact.

The Division appreciates this observation of the CoV. The issue of travel funds for Program Officers has already been addressed on Page 3 in response to a similar comment. As regards the observation that more “staff support would have a dramatic positive impact”, NSF and CISE continue to advocate for increases in staffing levels to accommodate the increasing volume and complexity of NSF work.

CoV PROCESS RECOMMENDATIONS

The CoV stated that the group felt that it was given a difficult task, with inadequate time, and little opportunity to pre-plan and prepare. Much could be done to make the CoV process more effective in future iterations in terms of improved pre-visit planning, cluster leaders arriving a bit early (half day) to think through the task, and the selection of a chair with prior CoV experience would be useful.

Each of the three CISE CoVs held this year commented on the longer lead time needed to better prepare CoV members to meet their challenging charge. CISE takes this feedback seriously, and accordingly will make significant adjustments in its CoV planning process. CISE very much appreciates the CoVs’ hard work and perceptive analysis and will do everything in its power to make the CoV process both more effective and more rewarding for CoV members.

The CoV had no simple way to study panel composition, the full set of proposals considered by particular panels, or to review cross-panel statistics. The CoV did not have direct access to CNS databases and would have found this more useful and perhaps more effective than ejacket. Further, although it is useful to have determined a sample of proposals ahead of time, with specific representativeness characteristics, all proposals should be readily available, not just those in the sample. This would have saved a lot of time in the CoV's analysis efforts.

The Division also agrees that direct access to the CNS database would be useful for the CoV to carry out additional data gathering and analysis. Unfortunately, NSF’s Enterprise Information System – a central reporting and analysis system that provides trend analysis, financial management, and personnel information on a variety of topics – is only available to NSF staff. It also is worth noting that although all proposals were available electronically, the relatively large number of proposals to be reviewed, coupled with the need to resolve conflict of interest, made access to additional proposals time consuming and caused additional delay in the process. CISE will look into including additional data in the self-study provided to CoVs to allow further analysis of the proposals as needed and in a timely fashion.

An improved sampling methodology is desirable. The 2009 CoV sample was performed by selecting every 20th proposal from a name-sorted list of projects, and then by performing sub-sampling within efforts that were underrepresented in the initial selection. It was not clear to us that this process is adequately random. For example, the initial selection clearly biases in favor of programs that received large numbers of proposals; and given that the initial selection included renewals and increments as well as newly funded proposals, the initial selection had an unexpectedly large number of accepted proposals.

It is challenging to create a random sample that is representative of a diverse portfolio of awards and declines, in terms of proposal class and type, PI gender, seniority and diversity, and geographic region. The need to keep the CoV members' workload reasonable further compounds the challenges. To meet these requirements, the CoV was provided with an "adjusted" Stratified Random Sample of 606 jackets (additional jackets were also made available upon request either electronically or in hard copy.) It was necessary to adjust the sample to ensure that the final proposal selection was representative of the Division portfolio of awards and declinations. CISE and CNS agree that the selection process might be improved. Prior to the next round of COVs, CISE will establish a small working group to explore and implement improvements to the CoV proposal/award sampling process.

The CoV did not have access to information about workshops used by CNS to elicit new directions and opportunities from research communities, and to define priorities. We learned of them mostly through dialog with program officers.

A link to a list of CISE/CNS workshops that were held during 2006-2008, along with their associated reports, was available in SharePoint. It is regrettable that the link was not easily locatable. CISE will rethink the layout of its CoV website and will dedicate additional time to demonstrate the capability of the site at the next CoV.